Core- X **Electromagnetics**

Course outcomes:

- Understand the fundamentals of Electricity and Magnetism, including concepts such as electric fields, magnetic fields, and electromagnetic waves.
- Analyze the behaviour of electromagnetic waves, including reflection, refraction, and wave propagation in different materials.
- Demonstrate knowledge of Maxwell's equations and their application in understanding the electromagnetic properties of materials

Unit-I

Electrostatic Fields: Coulomb‘s Law and Electric Field, Field due to Discrete and Continuous Charge Distributions, Electric Flux Density, Gauss‘s Law and Applications, Divergence Theorem and Maxwell‘s First Equation. Electric Potential, Potential due to a Charge and Charge distribution, Electric dipole. Electric Fields in Conductors, Current and Current Density, Continuity of Current, Metallic Conductor Properties and Boundary Conditions, Method of Images. Dielectric materials, Polarization, Dielectric Constant, Isotropic and Anisotropic dielectrics, Boundary conditions, Capacitance and Capacitors. Electrostatic Energy and Forces.

Unit- II

Poisson’s Equation and Laplace’s Equation: Derivation of Poisson‘s and Laplace‘s equation, Uniqueness Theorem, Examples of Solution of Laplace‘s Equation: Cartesian, Cylindrical and Spherical Coordinates. Magnetostatics: Biot Savert‘s law and Applications, Magnetic dipole, Ampere‘s Circuital Law, Curl and Stoke‘s Theorem, Maxwell‘s Equation, Magnetic Flux and Magnetic Flux Density, Scalar and Vector Magnetic Potentials. Magnetization in Materials and Permeability, Anisotropic materials, Magnetic Boundary Conditions, Inductors and Inductances, Magnetic Energy, Magnetic Circuits. Inductances and Inductors, Magnetic Energy, Forces and Torques.

Unit-III

Time-Varying Fields and Maxwell’s Equations: Faraday‘s Law of Electromagnetic Induction, Stationary Circuit in Time-Varying Magnetic Field, Transformer and Motional EMF, Displacement Current, Maxwell‘s Equations in differential and integral form and Constitutive Relations. Potential Functions, Lorentz gauge and the Wave Equation for Potentials, Concept of Retarded Potentials. Electromagnetic Boundary Conditions. Time-Harmonic Electromagnetic Fields and use of Phasors

Unit-IV

Electromagnetic Wave Propagation: Time- Harmonic Electromagnetic Fields and use of Phasors, the Electromagnetic Spectrum, Wave Equation in a source free isotropic homogeneous media, Uniform Plane Waves in Lossless and Lossy unbounded homogeneous media, Wave Polarization, Phase and Group velocity, Flow of Electromagnetic Power and Poynting Vector. Uniform Plane wave incident on a Plane conductor boundary, concept of reflection and standing wave.

Suggested References:

- ✓ *W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McGraw Hill*
- ✓ *Electromagnetic Field Theory Fundamentals, B.S. Guru and H.R. Hiziroglu, PWS Publishing*
- ✓ *Company, a division of Thomson Learning Inc.*
- ✓ *D. C. Cheng, Field and Wave Electromagnetics, Pearson Education*
- ✓ *M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Press*
- ✓ *J. A. Edminster, Electromagnetics, Schaum Series, Tata McGraw Hill*
- ✓ *Introduction to Electrodynamics, D.J. Griffiths, Pearson Education*